Manual of Telegraphy

AND

Catalogue of Electrical Instruments & Supplies

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MANUAL OF TELEGRAPHY.

A Few Words of Advise to Beginners.

If you want to become a first-class operator, the first thing to do is to get good instruments; next master their mechanical construction and build your line on a scientific basis; practice constantly and systematically and, if possible, secure the aid of a practical operator. If you desire to learn the Morse alphabet thoroughly and quickly, it requires constant practice. In order to do this, it is of advantage to possess a small portable instrument without a battery upon which to practice during any leisure moments you may have.

To meet the demand for such an instrument, we offer our Numbers 1 and 2 Mechanical Telegraph Instruments, shown on pp. 25 & 26, which are especially designed for this purpose. This instrument cannot, of course, take the place of our Number 1 or 2 Morse Learner's Instrument and Battery Outfit, because after the student has become proficient in reading and writing the alphabet, it is still necessary to use the battery instrument for practice, where the sender and receiver are in separate rooms or at a greater distance apart, with a Learner's Instrument in connection by wire.

Cut of said Instrument will be found on page 21 of this Manual.

To Learn Telegraphy.

Telegraphy can easily be learned, and the best time to learn the art of telegraphy is between the ages of fifteen and thirty.

The operation of telegraphy is not complicated. The instruments employed are simple and easy to manipulate.

Telegraphy has become vastly extended during the past few years; creating employment for thousands of telegraph operators yearly, in addition to those already in the service.

The salary paid to an operator ranges from thirty dollars to one hundred dollars per month, according to the skill of the operator and the size of the office.

An operator's progress is about as follows: After learning to "send" fairly and to "read by sound," one may obtain a situation in some

office, which may be a "branch" office in a city, or a small railway station.

The next step is to a larger office, where a greater amount of telegraphing is done and more skill is required.

The operator who has acquired skill by close application and continual effort to improve is soon known as a "first-class operator" and can, in the present state of the business, always find employment in any large city or important telegraph center. The way to become a successful first-class operator is: "*Practice constantly, and become thoroughly acquainted with every detail of your business and with every practical point connected with the apparatus and operation of the telegraph.*

After four or five months' steady practice a person is usually considered competent in the art of "sending" and "receiving" and to take charge of a telegraph office, and from one to two years' experience will enable almost any one to become a first-class operator.

It is always easier for a good operator to procure a situation at the regular rate of pay for first-class skill, than it is a third or fourth-rate operator to obtain employment at any price.

It is not unusual for telegraph operators to combine other occupations in railway, express, and mercantile business with that of telegraphy in such a way as to make their positions handsomely remunerative, and thus lead their own way into more important and profitable business.

Explanation of the Telegraph.

In order to telegraph by the Morse System it is necessary to employ, first, the Battery which produces the current of electricity; second, a line wire which conducts the current produced by the battery from one point to another; third, a transmitting key which closes the circuit and causes, by means of the Electro-Magnetic Apparatus called the Sounder, to give out in sounds or sounding strokes all signals which are made by pulsations of the current from a distant point.

The student, who has the intention of becoming an operator, should become thoroughly familiar with all the practical features of the apparatus and mechanism of the telegraph. The first to be considered, being the first essential part of a telegraphic apparatus, is the battery; consequently we will take up the battery first. It is by the chemical action in the battery that the electric current is first generated. In practical telegraphy this current is made to traverse long or short distances through the conducting medium of metallic wires and by means of the proper instruments, which are herein described, made to give out tangible signals, which, being arranged in the form of an alphabet, enables us to read or speak instantaneously through great distances,

for the electric current requires but a second to travel many hundred miles over the wire.

The ordinary gravity battery consists of three parts, namely: the Jar, the Zinc, and the Copper.

The Jar is of glass, and is about five inches in diameter by seven inches deep. The Zinc forms the negative pole, while the Copper forms the positive pole. The Zinc is hung from the side of the Jar into the solution, and the Copper, which is formed by uniting three strips of copper at the center and then spreading the strips apart, rests on the bottom of the Jar, and from the end of one of the strips an insulated wire is run up the side of the Jar.

The solution consists of water, blue vitriol and sulphate of zinc, the proportions of which will be given hereafter.

When the battery is charged for operation, if the wire projecting upward from the copper be connected with the zinc by binding the bared end of the wire under the screw in the arm of the zinc, a current of electricity will constantly flow through the wire from the copper to the zinc and will immediately cease to flow upon disconnection; the same action will take place through any length of wire.

When a powerful current is required, additional cells are added by connecting either the copper or zinc pole of the first cell to the opposite pole of the next; in this way a series of fifteen or twenty or a hundred cells may be connected, while it is only necessary to connect one unconnected pole at each end of the series to close the circuit.

Usually one cell of battery is allowed for the first mile of line wires, one cell of battery for the two ground wires, one cell for each twenty open instruments on the line, one cell for each additional mile of line wire.

When light wire, say No. 14, is used, the resistance being greater, or should the conductor of the ground be unfavorable, double the amount of battery power will be necessary. As a general rule, one battery is allowed for every forty ohms of the entire resistance of the line.

Insulation and Conductors.

Through certain substances electricity will conduct more freely than through others; through some it will not pass at all. Those substances which conduct the current are called conductors; those which do not are called non-conductors. The principal materials used for conductors are copper, iron, brass, and platinum. For insulating purposes, gutta-percha, glass, silk and cotton fiber, dry wood, bone, ivory, hard and soft rubber, and mica, which are non-conductors, are used.

Iron wire is usually employed on account of its durability and cheapness for outside purposes, while copper is generally used for

wiring inside of buildings. The copper wire used for inside wiring is usually insulated by means of wrapping a continuous covering of silk or cotton fiber, or coated with gutta-percha. When iron wire is used for outside work, it is only necessary to insulate it at such points where it is supported upon the poles or against walls, or wherever it is liable to come in contact with walls or portions through which it is desired to pass it; in the case of supports against walls, or on poles, glass insulators are used. These insulators fit over the end of a wooden pin, called a bracket, which is then fastened to the pole or wall and the wire tied by means of a tie wire to the glass end. Hard or soft rubber tubes are used when the wire passes through walls and partitions. The handles or knobs of instruments are generally made of hard rubber.

To Use the Earth as a Return Wire.

In this case the earth is used as a "return" wire. It is done by attaching the ends of your wire to the earth in such a way as to have the opposite poles carried any distance away and also connected with the earth. The current will flow, owing to the moisture which is present beneath the surface of the earth as readily as though the circuit had been made complete by means of a return wire.

There are two ways of making a grounded circuit; the one is to fasten (preferably by soldering) the end of your wire to gas or water pipes which enter the ground, and so ground your wire. The other is to solder the end of your wire to a copper plate and then bury the plate edgewise about four feet underground. As to which is the best method depends upon the character of the ground in which you ground your wire. If the soil, in which your pipes run, is rocky, sandy or dry, the second method is the best (for dry ground offers the most resistance). In that case the line can be extended a short distance to a damp spot or where moist, clayey soil can be found. This will offer less resistance. Your plate should be about 30 x 30 inches. The larger the plate the less the resistance.

Magnets and Keys.

Telegraphic mechanism is based entirely upon the Electro-Magnet and Transmitting Key.

The Electro-Magnet is constructed in the following manner: the magnets consist of two spools, with hard rubber ends and round cores of soft iron. These spools are wound with silk-covered copper wire until the diameter of about an inch and a half is attained; a piece of hard rubber tubing is then slipped over each spool. This entirely encloses the wire, leaving only the cores exposed through the ends of the spools. The spools are fastened together side by side by means of a

short flat piece of soft iron, called a "back bar" or "heel piece," which is fastened to the ends of the cores; on the other end of the spools is placed a movable piece of iron, called the Armature, which is about the width of the diameter of the cores. It is so placed that a current of electricity, passing through the wires surrounding the cores, causes the cores to become magnetic and to attract the armature; but as soon as the "circuit" is broken, the magnets will not again attract the armature until the current is again turned on.

The Key is a contrivance for making or for breaking the contacts which control the passage of the current. It consists of a steel lever, swung on a pivot, having a rubber handle, which the operator grasps lightly with the thumb and forefinger. When the lever is pressed down, it brings a platina point, which is placed under the lever, in contact with another insulated platina point placed in the base of the key to correspond with the one in the lever. The platina point in the base being insulated, there can be no connection between the base and the lever until the contact is made, as one wire runs from the point in the base, another from the lever, a connection is made and the circuit closed. Platina is used where the contacts are made and broken, because it does not readily fuse or tarnish. An extra lever at the side of the key, called the "circuit closer," which, when the operator is not using the key, is used as a means of keeping the circuit closed.

The foregoing cut represents the basis of the telegraphic system.

The student, after having read carefully the preceding remarks on batteries, keys, and magnets, will understand readily the application of each at a glance at the diagram given here. The platina points in the key close the circuit and cause the cores in the electro-magnet to attract the armature, thus giving a signal at the other end of the line. These signals are rendered intelligible by means of dots and dashes, as will hereafter be explained; on this attracting and releasing of the armature by the breaking and closing of the circuit by the key at the

other end of the line is based the whole system of telegraphy. The motions made on the key by the operator on one end of the line are dublicated by the armature at the other end.

To Set up the Instrument and Battery for Practice.

The battery is put in operation as follows: First, spread your copper, set it into the bottom of the jar with the insulated wire extending upward and out of the jar; then put enough water into the jar to fill it about two-thirds; next drop carefully into the bottom of the jar, around and between the leaves of the copper, one-half pound blue vitriol and two ounces of sulphate of zinc.

Then hang the zinc, "Crowfoot," into the jar so that the hook will catch the side of the jar and hang suspended just below the surface of the water, and the battery is ready for operation. It will not, however, work at full power until it has been in use for about three days. This can be hastened to a great extent by putting the battery on what is called "short circuit," which means simply to shorten the circuit, that is, to fasten the end of the wire from the copper into the clamp screw of the zinc, and letting it stand for about twelve hours.

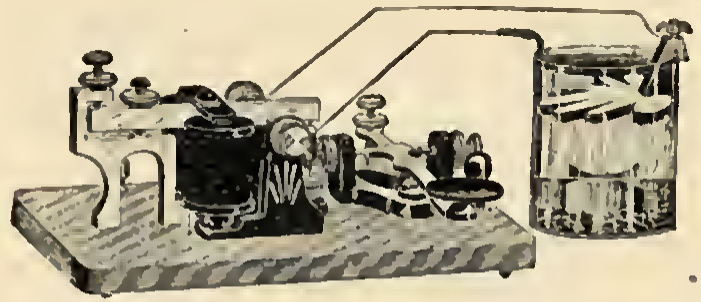
The battery should always be kept supplied with enough sulphate of copper, which, being heavier than the sulphate of zinc, sinks and gives a blue color to the liquid in the bottom of the jar. This blue color should rise to within an inch of the bottom of the zinc; should it rise higher, it shows that too much sulphate of copper is being used, and no more should be put in until the blue has receded almost to the bottom of the jar, when more sulphate of copper must be added. Water, too, must be added from time to time to replace the loss by evaporation.

As long as the battery continues in action, there is an increase of the quantity of the sulphate of zinc in solution in the upper part of the jar. A hydrometer is convenient for the purpose of testing the strength of the solution. When the specific gravity is less then fifteen degrees, the sulphate of zinc solution should be strengthened, when it is thirty degrees or more, a portion of the top of the liquid should be drawn off with a syringe or cup, and replaced with fresh water.

Once in eight weeks, or three months, it will be necessary to thoroughly clean the battery. Take out the zinc carefully, and clean it by scraping with a knife and washing; pour the liquid into a separate jar. Now take out the copper and clean it, throw the sediment away, and clean the jar. Pour the clean liquid back into the jar again, replace the copper and zinc, add water enough to cover the zinc, and put in a few crystals of sulphate of copper, and the battery will again be ready for use.

In joining together any number of cells, whether of the same or of different kinds of battery, the positive pole of the first cell must be connected with the negative pole of the second cell, the positive of the third, and so on throughout the whole series. It matters not which pole you commence with, if you are only careful never to connect like poles. This law must be as strictly observed in joining batteries hundreds of miles apart as if they stood side by side.

No battery should be permitted to freeze, for while frozen the current is very much impaired or entirely suspended. A battery while warm works more vigorously, as heat is a promoter of chemical action. The connections must be kept free from rust or dirt, in order to allow the current to pass through them freely.



Having set the battery according to the preceding directions, connect one wire from the copper pole of the battery to one of the brass binding-posts at the back of the instrument, as shown above, and one wire from the zinc pole to the remaining binding-post; screw down the instrument firmly to the table with the screw in the base, as its best sound is thereby produced. See that none of the screws are loose in their places and that the armature lever, which is the speaking tongue of the telegraph, plays freely, with a movement of about one-sixteenth of an inch. The spring, which draws the armature lever upwards and is called the *adjustment*, should only be set at sufficient tension to raise the lever when no current is passing through the magnets. When the instrument is not in use, leave the circuit-closer of the key open about half the time. This will keep the battery well at work. See that the platina points of the key are kept clean from dirt or dust, this preventing imperfect contacts from being made.

The key is provided with screws for the purpose of regulating its play to suit the hand of the operator.

Practice Should Mainly Consist of Three Kinds.

I. Morse writing with the Key and without a companion.

II. Combined Morse writing and reading with a companion student.

III. Practice in both Morse writing and reading of messages, social conversation, printed matter, and the Exercises, where the two or more persons practicing are in separate rooms, or at a distance, and entirely dependent upon the wire and instruments for their communication with each other.

A great amount of single practice should at all times be kept up, as it brings that thorough and unhesitating familiarity with the Morse signals, which is necessary before any one can become a telegraph operator. This familiarity with the Morse signals becomes, when fully acquired, as easy as the exercise of speech. An operator does not have to *think* before making a Morse letter on the key any more than he or she does before speaking a word in the English language.

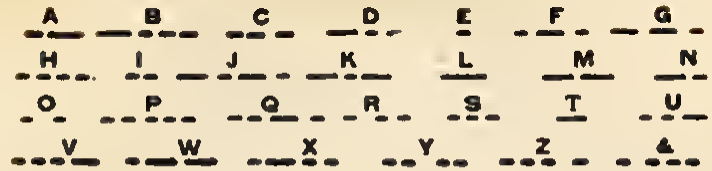
Alternate key writing, or "sending" by one student while the other practices at listening and reading the words that are sent, and in copying them, should next be tried.

Considerable training at this work is necessary to enable the students to become sufficiently familiar with the *sound* of the Morse letters, as made by each other, to read what is sent with the key. This practice serves to correct inaccuracies in sending the signals, for each one must make the signals correctly, or they cannot be read by the other.

As soon as two persons have pursued the above system of practice until they have become able to hold a conversation of short sentences in "Morse" with each other, they should begin the separated practice, which is the last and most interesting step in learning telegraphy, and in preparation for the duties of an operator. Set up the instruments in separate rooms, connect them with each other by wire, as explained elsewhere in this book, and practice at sending and receiving messages, printed matter, and conversation, copying everything as it is received.

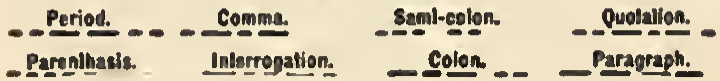
Wherever it is possible, the student should secure an opportunity to finish his or her practice in a telegraph office. A few weeks of such practice will familiarize the student with the every-day work of a telegraph line, give excellent opportunity to practice at reading by sound in copying the constantly passing messages, and will thoroughly prepare the applicant for a situation as an operator.

The Morse Telegraph Alphabet.



NUMERALS.

PUNCTUATION.



The Morse alphabet consists of what are called dots, dashes and spaces. Combinations of these make intelligible signals. Many of the characters will be found to be the reverse of others: such as, A is the reverse of N, B of V, D of U, C of R, Q of X, Z of &; so if the formation of one of each of these letters be obtained, its reverse is easily mastered. C, E, H, I, O, P, R, S, Z, Y are merely represented by dots and spaces, and if due regard be given to time, they will be found very easy to commit to memory.

The first step is to memorize the alphabet, so that each character can be called to mind at will: thus, A, dot and dash; B, dash and three dots; C, two dots, space, dot, etc. The period is the only punctuation mark in frequent use, and the student need not learn the others at first.

A dot (E) is made by a single instantaneous, downward stroke of the key. A short dash (T) is made by holding the key down as long as it takes to make three dots. A long dash (L or cipher) is made by holding down as long as required to make five dots. A cipher is prolonged as to occupy about the time required for seven dots.

The intervals between dots or dashes in the same letter are called "breaks." A space in letters should occupy the time required for a dot and break. The space between letters should occupy the time required for two dots and breaks.

The space between words should occupy the time required for three dots and breaks.

In letters that do not contain spaces, the dots and dashes should follow each other as closely as possible.

The beginner should be careful to form and space his letters correctly, as this will lead to a perfect style in sending.

Position and Movement.

There should be no change in the tone of a sounder, the letter being determined solely by the "time or times" the lever is up or down. The back stroke, so called, is as necessary to reading by sound as the down stroke, and these must be distinguished each from the other; for, without it, the duration of the downward movement could not be determined.

Place the first finger on the top of the key button, with the thumb under the edge and the second finger on the opposite side. Curve the first and second fingers so as to form the quarter section of a circle. Partially close the third and fourth fingers. Allow the wrist to be perfectly limber. Rest the arm on the table at or near the elbow.

Let the grasp upon the key be firm, but not rigid. Never allow the fingers or thumb to leave the key, nor the elbow to leave the table. Avoid too much force, or too light touch, and strive for a medium firm closing of the key.

The motion to be imparted is directly up and down, avoiding all side pressure.

The movement is made principally at the wrist, although the finger and hand must be perfectly elastic.

The fingers, wrist, and arm should move uniformly in the same direction.

The downward movement produces the dots and dashes, and the upward the breaks and spaces.

Commence the use of the key by making dots in succession at the rate of two every second, and increase the speed five-fold as skill is acquired. Continue to practice dots until 360 per minute can be made with perfect clearness and regularity.

When dots can be readily made as directed, begin with dashes at the rate of two in every three seconds, and gradually increase until 120 per minute can be made with perfect regularity.

Next attempt the long dash, at the rate of one every second, and increase to ninety per minute.

When perfection is attained, take up the following exercises in order.

Repeat each exercise until every letter can be made at will correctly.

Dot Letters.

Dot and Space Letters.

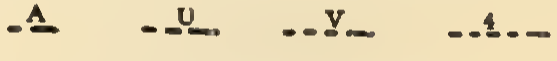
Take pains to make spaces uniform, and in the proper place.

Dash Letters.

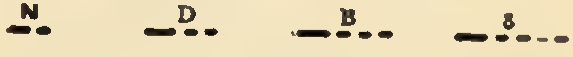
Be careful to proportion short and long dashes accurately.

Dots, with Dash, in Succession.

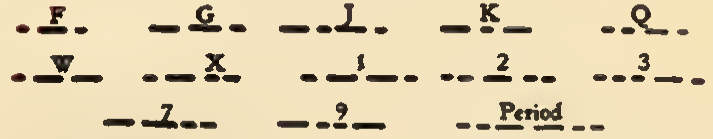
Avoid leaving any space between them.



Dash, with Dots, in Succession.



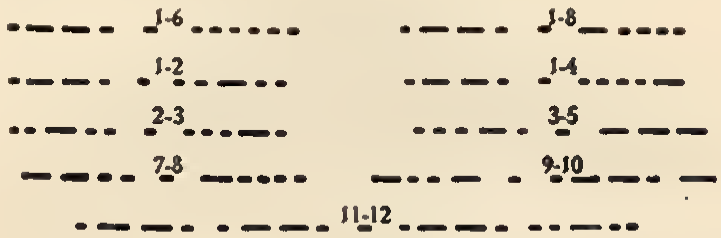
Dashes or Dots in Mixed Combination.



There are almost as many styles of sending among operators as of penmanship. It is quite possible, on a line where forty operators work, to tell each one by his manner of manipulating the key. Cultivate a firm, even, smooth style of sending. The fast writers do not dispatch the most business. Graduate your writing to the capacity of the receiver, and never crowd him.

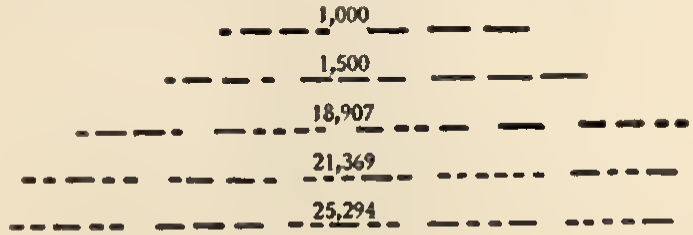
Fractions.

Fractions are made by substituting a dot for a hyphen between the figures.



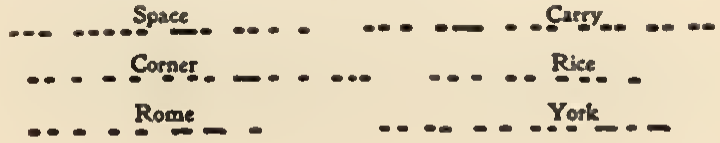
Numbers.

In large numbers, a short space is usually made between every three figures.



Unusual Spaces.

In words largely composed of dots and spaced letters the spaces should be larger than usual between the letters.



Words.

After the student can write the words in this exercise satisfactorily, he may arrange several series himself for practice.

Send	Bunnell	Return	Limited
When	Always	Barn	Interstate
Answer	Seven	467½	English
Bright	Mail	Bay	Past
Morning	Begin	Countersign	Handle
Call	Sail	Arrive	Entertain

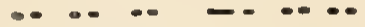
Sentences.

The student may take such sentences as he chooses for practice, always being careful to write one correctly before commencing with another.

Office Calls.

Every telegraph office has a name or call, which usually consists of one or two letters; thus, the call for Baltimore is B; Philadelphia, P; New York, N. Y. If Philadelphia desires to communicate with New York, he repeats the latter call on the line till answered. It is proper to sign one's own office every three or five calls, so that others may know who is using the wire. Thus:

If New York hears the call, he opens his key and answers by repeating "I" several times, and signing his own call, thus:



When answered, Philadelphia proceeds with his business. The process is the same between any other two offices.

Abbreviations and Word Signs.

1, Wait a minute.	Frt., Freight.
2, What time is it?	G. M., Good morning.
4, When shall I go ahead?	G. N., Good night.
5, Have you anything for me?	Gg., Going.
8, Am busy.	Gd., Good or ground.
9, Testing wire (calls for right of way).	G. B. A., Give better address.
13, Do you understand?	G. P. M., Good afternoon.
18, What is the matter?	G. A., Go ahead.
27, Adjust your key.	Ha, Means a laugh.

(Abbreviations and Word Signs—*Continued.*)

45, Answer quick by telegraph.
73, Accept my compliments.
77, Have a message for you.
134, Who are you at the key?
Ads., Address.
Ahr., Another.
Ans., Answer.
Btn., Between.
Btr., Better.
Bk., Back.
Bf., Before.
Bn., Between.
Bat., Battery.
Bbl., Barrel.
Ct., Cannot.
Ckt., Circuit.
Col., Collect.
Ck., Check.
Co., Company.
Dnt., Don't.
D. H., Deadhead (free).
Ex., Express.
Fm., From.
Hm, Him or home.
Immy., Immediately.
Impt., Important.
Kw., Know.
Min., Minute.
Msgr., Messenger.
Msk., Mistake.
No., Number.
Ntg., Nothing.
N. M., No more.
O. K., Allright.
Ofs., Office.
Opr., Operator.
Pls., Please.
Pd., Paid.
P. O., Post Office.
Q. K., Quick.
R. R., Repeat.
Sig., Signature.
Sine, Give office signal.
Tt., That.
Um, Means a grunt.
Wt., What.

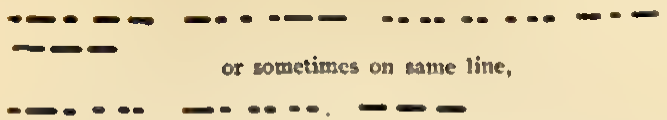
Messages.

Commercial messages may be divided into five parts, viz.: Date, address, body, signature, and check. The date is composed of the name of the place where the message originates, the month, day of month and year. An operator accepting a commercial message for transmission should be careful that this is written out in full, as follows: NEW YORK, July 10, 1901.

In actual transmission, the month and year are always omitted. Between offices on the same circuit the office call is frequently used, and the date omitted. The date should always be given in commercial business. This is always done when the message goes beyond the line where it originates. In sending a message, the date is always prefixed by "From," abbreviated to Fm. or Fr.

FORM OF MESSAGE.

From NEW YORK, August 5, 1900.



or sometimes on same line,

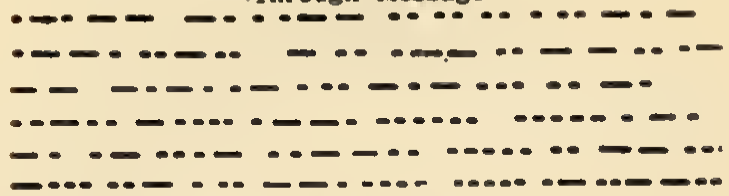
The address should comprise the full name and place of the person to whom the message is addressed. When not known, the number and street should be given, as well as the place of destination and State. The word "To" always precedes the address, and a period divides it from the body of the message. When the office to which a message goes is on the same line, only the office call is written. When the message goes through, the destination is spelled out in full.

FORM OF MESSAGE.

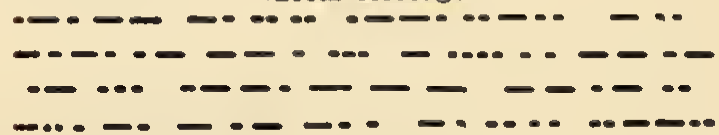
From NEW YORK, May 12, 1900.

To WILLIAM JACKSON,
2816 Penn. Ave., Pittsburg, Pa.

(Through Message)



(Local Message)



The body of the message is embraced between the period and signature. No abbreviations are permitted; if inserted, each letter is charged for. Compound words are usually considered one word. Numbers are written out in full; if figures are inserted, they are paid extra for. The body of some messages are written in cipher, being composed of disjointed words, having no sense unless interpreted by means of the key in possession of the sender and receiver.

FORM OF MESSAGE.

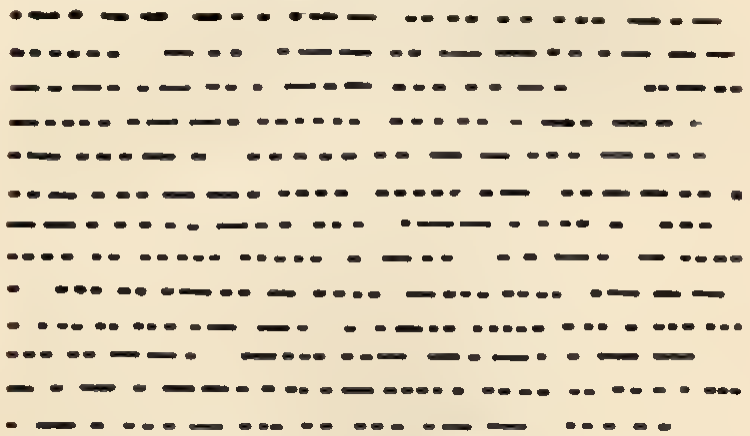
From NEW YORK, June 6, 1900.

To WILLIAM JACKSON,

2816 Penn. Ave., Pittsburg, Pa.

Goods were shipped on the sixth by American Express.

Sig., BUNNELL TELEGRAPH & ELECTRICAL CO.

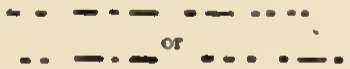


The check follows the signature of a message, and gives the number of words in it subject to tariff. It aids in preventing omissions and errors. The check also tells whether a message is paid, collect, or free. If free, it usually explains why.

Upon full-paid business, ten words can be sent as cheaply as one, but for all over ten an additional rate (per word) is charged. The date and address of a message are not counted. The body of a message is always counted. The extra signatures, titles and directions after signatures are counted. When there are several signatures, the last one goes free. Upon half-rate messages, the same rule applies, except that the tariff is computed at one-half of full rates.

The "From," "To" and "Sig." in a message are never copied by the receiver.

When an office is through receiving a message, he must always say "O. K." and sign his office, thus:



or

If no O. K. is received, it will be known that the message has not been properly received, and must be repeated.

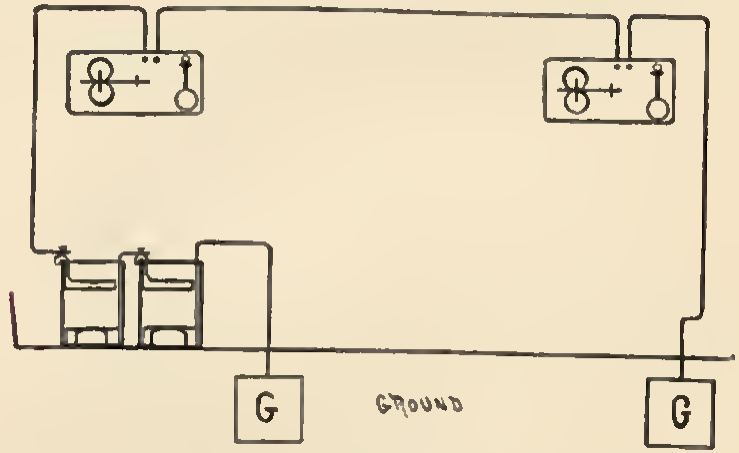
When the sender discovers that he has made a letter wrong, he stops, makes more than six dots, says "msk." (mistake), and commences again with the last word made correctly.

When the receiver finds he is not getting a message correctly, he breaks and tells sender to "G. A." (go ahead) the last word received.

After receiving a message, the operator should be careful to see that he has the right number of words as called for by the check of the message. If they do not agree, he should compare with sender till error is found. This is usually done by commencing at period, and writing the first letter in each word till the missing portion is discovered.

Few operators are capable of sending and receiving forty words per minute; thirty-five words is rapid work. The average speed does not reach thirty words. When the student is capable of sending and receiving promiscuous messages at the rate of thirty words, he may begin to look for an office.

To Connect Two Instruments with a Short Line.



Connect the wire from the copper pole with your ground wire and the wire from the zinc pole to the binding-post on the instrument. Connect the line wire to the opposite binding-post at the other end of the line and attach the wire to one binding-post. Then run a wire to the ground from the opposite post. If part of the battery is used at each end of the line, always be careful to have the zinc and copper poles of the battery towards each other.

Private Lines.

In the construction of short lines, No. 12 galvanized wire is chiefly used, being of light weight and cheapest for the purpose, and measures thirty ohms resistance to the mile.

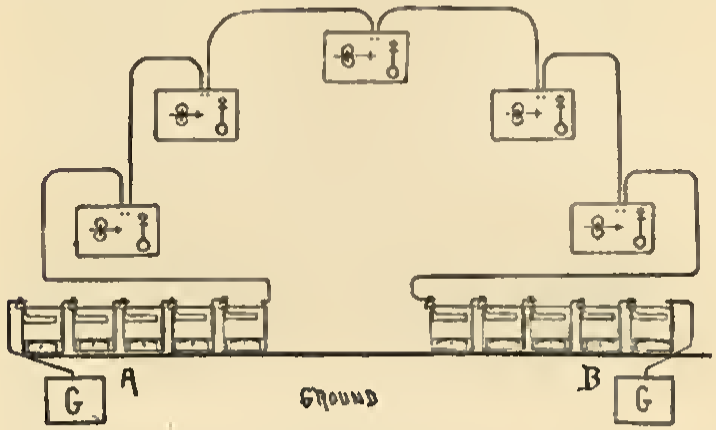
Only one wire is necessary to the construction of a line, the earth being used for the return circuit.

Great care should be taken to have the earth connections perfect. Instruments on the same line must always be of the same resistance. Whatever other difference there may be in the instruments, they should be all alike in resistance.

For lines between one or twelve miles in length, the instruments are required to have magnets wound with finer wire than those used on currents of less than one mile. Such instruments are designated as being of "20 ohms resistance."

In ordering instruments give the length of line and the number of instruments to be used on it.

Private Lines with Several Stations in Connection.



Connect wires, instruments, and batteries on such a line as shown in the diagram above, placing the batteries at each end of the line.

Battery at A has its zinc pole connected to the earth and its copper to the line. Necessarily, therefore, the other battery at B presents its zinc pole to the line and its copper to the earth. Were both batteries connected with the same pole to the line, they would neutralize each other, and no current would be produced.

The line is connected from the battery to the first instrument and on the next in such a way that the current is made to pass through every instrument on the route.

It is necessary, when two or more offices are connected on a line, that every key be kept closed by having the circuit closer shut, except only when sending communications. If any one key on the entire line is left open, all communication is stopped.

In running an out-door wire between points at any distance apart, it should be insulated by means of glass or rubber insulators from contact with the buildings, trees or posts, so as to prevent the escape of the current into any object it might come in contact with, and thus reach the ground before going through the instruments. To make a joint or splice in wire, scrape the ends of the wires to be joined with a knife or a file until they are clean; then twist them tightly together with the aid of a pair of plyers.

Wires for use inside of buildings should be of copper and insulated with cotton or gutta-percha. They should be fastened with staples, and care taken not to break the insulation.

Main lines of telegraph are arranged in the same manner. With wires of many miles in length, main batteries containing a large number of cells are placed at the end stations and the return made by means of the ground wire, and each office connected to the line in the manner described. Tapping a wire is done by simply cutting a wire and connecting the instruments with the two ends. Whatever passes over the wire can then easily be read.

The Relay.

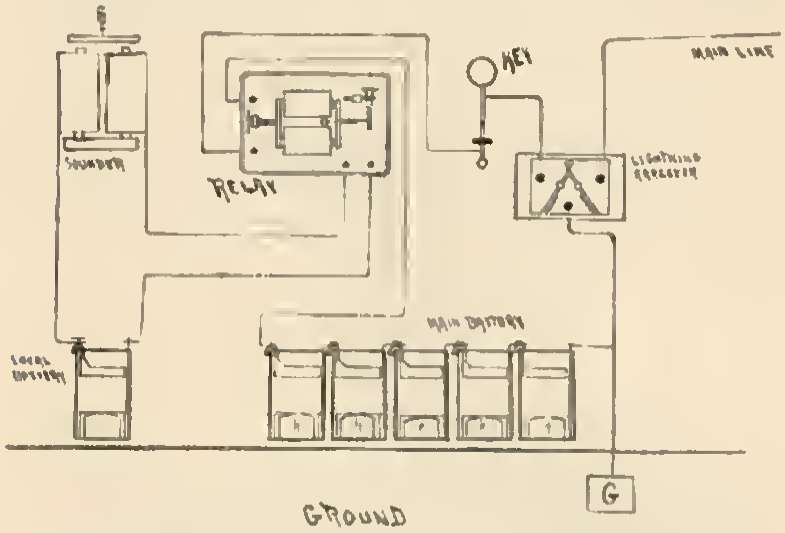
The Relay is a main line instrument. It is simply an armature hung in front of two spool magnets in such a way as to be susceptible to rapid vibrations. These vibrations are unlike those of the key which are made by hand with the assistance of a spring. The vibrations of the relay are automatic, and are caused by the applications of two forces, in one direction by the constant pull of the spring or mechanical force, in the other by the intermitted application of magnetic force generated in an electro-magnet. The object of this vibration is to open and close an electrical circuit called the local circuit.

There are four binding-posts in the base of the Relay. Two of them form the terminals of the wires of the electro-magnet and answer for the attachment of wires leading to the main line; the other two are connected with the local contact points and serve to accommodate the wires leading to the sounder and local battery.

By simply opening and closing a key on the same circuit with itself, no matter how near to or how far from the Relay it may be, magnetism is generated in the electro-magnet and discharged there-

from intermittently, and the two forces above referred to are so proportioned to one another and the armature that where there is no magnetism present the spring is strong enough to pull the armature away from the electro-magnet. The spring, however, must be so regulated as to be weak enough to be overcome by the power of the magnetism, when the current is let into the magnets and permit the armature to be pulled up against the end of the spools.

When the current comes over the main wire, weakened from traveling a long distance, it passes into the Relay. The armature of the Relay is so delicately hung as to be moved by the slightest current, and the current, punctuated into dots and dashes, passes through the Relay and then to the sounder, which, aided by a local battery, gives the message from the main line clear and distinct.



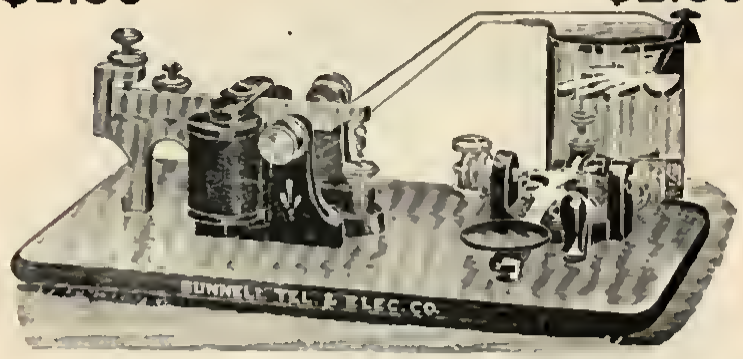
The above cut shows the best method of connecting the Lightning Arrester and Relay on a grounded circuit consisting of only two stations.

Lightning Arresters.

As lightning is frequently attracted to out-door lines and thereby enters the office, sometimes damaging the instruments, or even setting fire to curtains or other inflammable materials about the instrument table, a simple and cheap instrument, called "Lightning Arrester and Cut Out," is used for the purpose of intercepting and carrying to the earth such discharges of lightning as would be liable to cause damage. This apparatus is entirely effective, and is a complete safeguard against lightning.

THE MORSE LEARNERS' OUTFIT No. 1.

$2.50 OUTFIT COMPLETE. **$2.50**



The "MORSE" OUTFIT is a full size, well made complete MORSE TELEGRAPH apparatus of the latest and best form for learners, including handsome giant Sounder with **Steel Lever** (Solid Trunnion) **Key**, and large Cell of the best Gravity Battery, latest form

It is the best working set of Learners' Instruments for short or long lines, from a few feet up to 20 miles in length, yet offered

The Sounder Levers, Sounder Yokes, Adjusting Screws, etc., are in finely finished BRASS Composition, the same metal as in all other first-class instruments.

The Magnets are strong The Sounder is loud and clear The Key is the celebrated Steel Lever Key, known everywhere as the only perfect Key

PRICE.

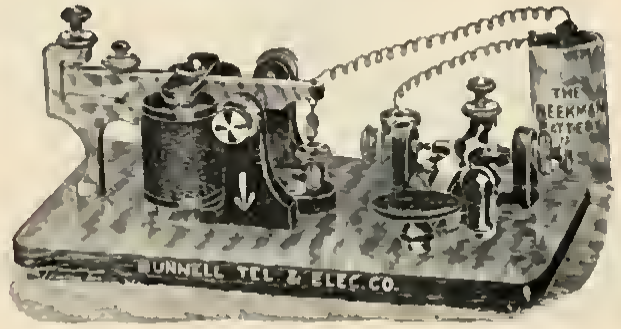
MORSE OUTFIT, Complete, with Battery, Book of Instruction, Wire, Chemicals, and all necessary material for operating	$2.50
"Morse" Instrument alone, without Battery	1.50
Cell of Battery, complete, 5 x 7	0.50
"Morse" Learners' Instrument, without Battery sent by Mail prepaid	2.25
"Morse" Instrument, wound with fine wire, 20 ohms resistance, for use on out-door lines of from 200 feet to 10 or 15 miles in length, without Battery, etc:	2.00
Same, sent by mail, prepaid	2.50

BATTERY CANNOT BE SENT BY MAIL.

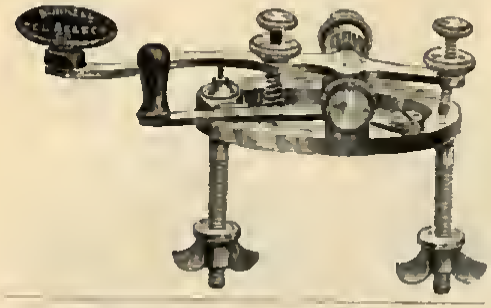
THE

"Bunnell Tel. and El. Co." Learners' Outfit No. 2.

Price, complete, $1.75.



STEEL LEVER SOLID TRUNNION KEYS.



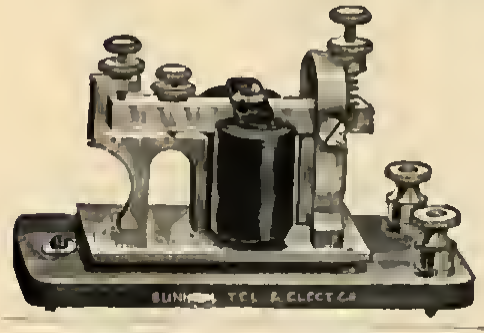
Leg Pattern.

Brass Finish . . $1.50
Nickel Plated . . 1.70

Legless Pattern.

Brass Finish . . $2.00
Nickel Plated . . 2.25

SOUNDERS.

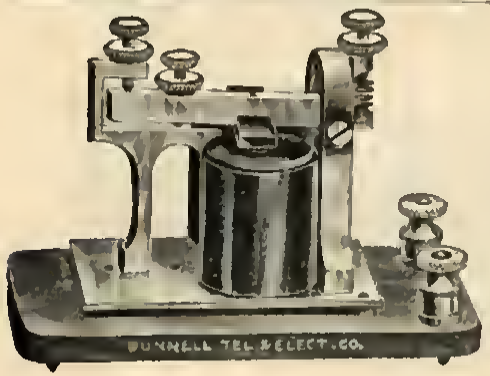


New Aluminum Lever Giant Sounder.

Price, $2.00.

Wound with fine wire to 20 ohms resistance for Main Line use (without Relay) on lines up to 15 miles in length, $2.50

Nickel Plated, 50 cents extra.



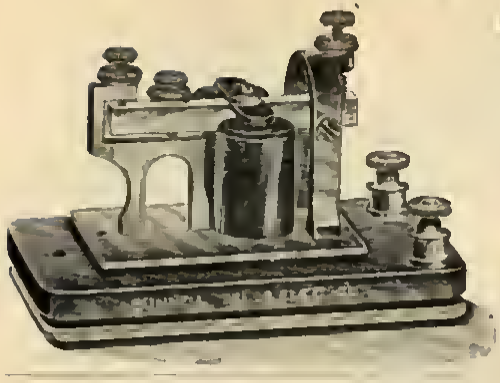
The Bunnell Giant Sounder.

PRICE,

4 ohms $2.75
20 ohms 3.25

Nickel Plated, 50 cents extra.

SOUNDERS.



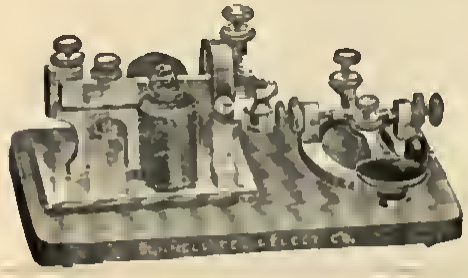
The New

Aluminum Lever Sounder.

With Jesse H. Bunnell's Patent Aluminum Resonator Base.

Price $2.75

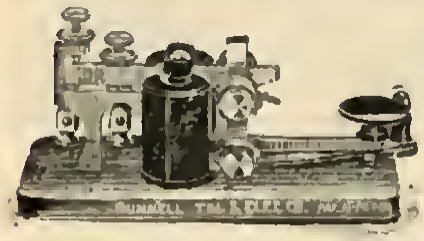
COMBINATION SETS.



Giant Combination Set.

Consisting of Aluminum Lever and Sounder and Steel Lever Key for Private Lines and Learners.

Price, $3.50.



THE

Beekman Electro-Mechanical Learners' Combination Set.

Can be used on circuit for sending and receiving, or as a mechanical, without detaching from the line.

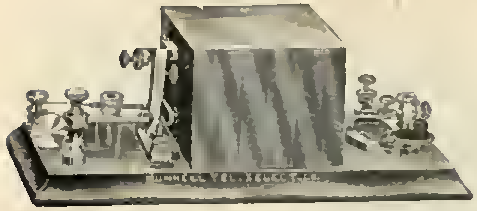
4 ohms, with Battery, etc. . $4.00
4 " Instrument only . 3.50
Nickel Plated, 50 cents extra.
20 ohm Instrument only . . 4.00
The set for out-door work, complete 9.00
The set for in-door work, complete 8.50

SOUNDING RELAYS.

Main Line Sounding Relay.

With key on base, 150 ohms $8.00
With key on base, 200-300 ohms . . 8.50
Without key, 100 ohms, 7.00
Without key, 200-300 ohms . . 7.50

SOUNDING RELAYS.



Box Sounding Relay and Steel Lever Key Combination Set.

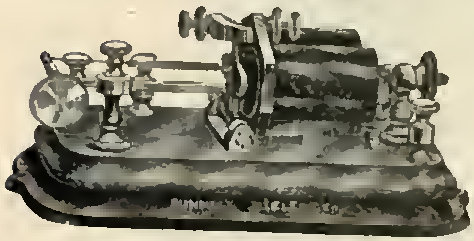
Price, with key on base,

150 ohms	$7 50
200 "	8.00
300 "	8.50

Price without key,

150 ohms	5.75
200 "	6 25
300 "	6.75

RELAYS.



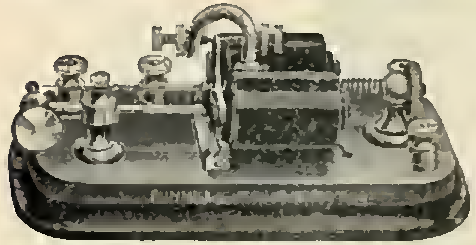
Bunnell Main Line Relay.

with Solid Trunnion Single Piece Armature.

Price,

150 ohms resistance,	$6.50
200 " "	7.00
300 " "	7 50

Nickel Plated 50 cents extra.

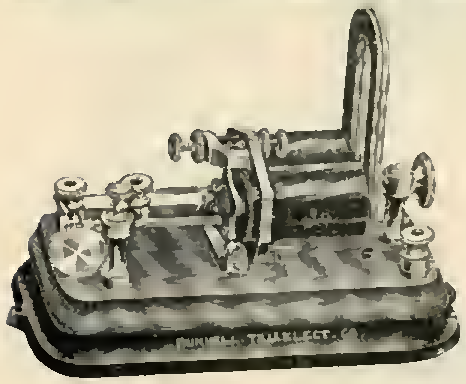


Standard Relay.

Price,

150 ohms resistance,	$5 50
200 " "	5.75
300 " "	6.00

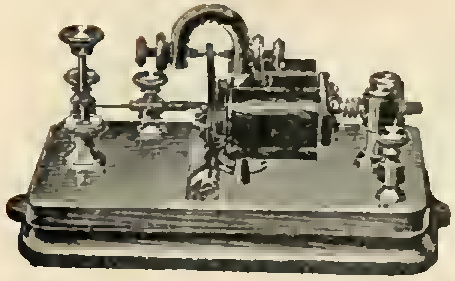
Nickel Plated 50 cents extra.



RAILROAD RELAY,

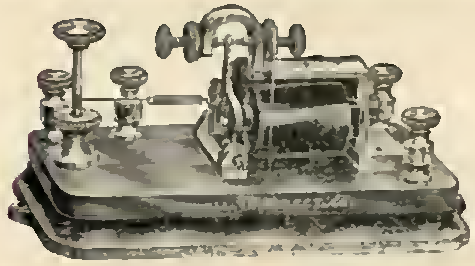
Price, . . . $6.00

PONY RELAYS.



The Beekman Pony Relay.

Price, 30 ohms.	$3.00
" 50 " .	3.50
" 75 "	3.75
" 100 " .	4.00



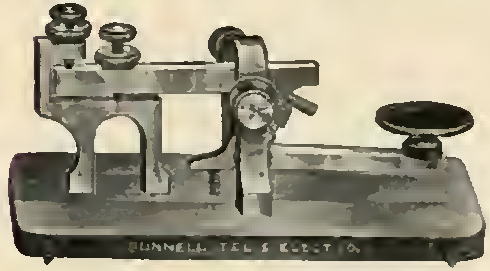
The New Form Pony Relay.

Price, 4 ohms . .	$2 75
" 20 " . .	3.00

The National Pony Relay.

Price, 20 ohms	$1 25
" 50 " .	4.75
" 75 " . .	5.00
" 100 " .	5 00

MECHANICAL LEARNERS' INSTRUMENTS.

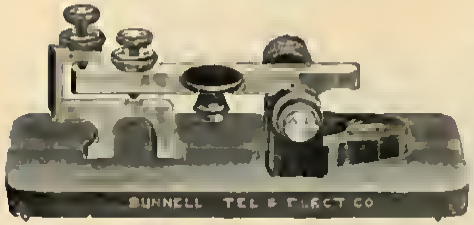


Improved Mechanical Learners' Instrument No. 1.

Price, ... $1.25

With Telegraph Instruction Book. Sent anywhere in the United States, by mail, prepaid, on receipt of list price, in stamps, postal or express money order, or registered letter.

Mechanical Learners' Instruments.



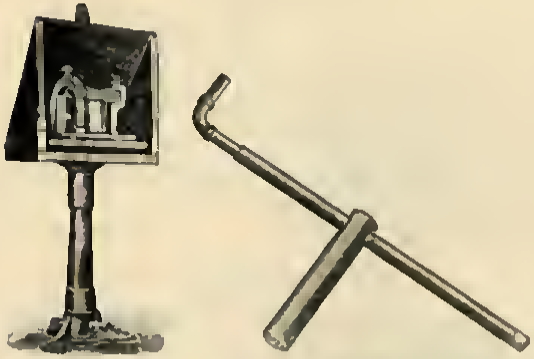
No. 2

Mechanical Learner's Instrument.

With Telegraph Instruction Book. Sent anywhere in the United States, by mail, prepaid, on receipt of the price in stamps, postal or express money order, or registered letter

Price, - $1.00

RESONATORS.



THE SKIRROW EXTENSION ARM RESONATOR

With Arm and Sounder

Price, $10.00

Adjustable Resonator.

Without Sounder	$3.75
With Cord and Sounder	6.00

The Jones' Resonator.

Postal Telegraph Style, with Message Clip and Lateral Adjustment

With Sounder and Cord	$6.00
Resonator only	2.75
Cord only	0.25

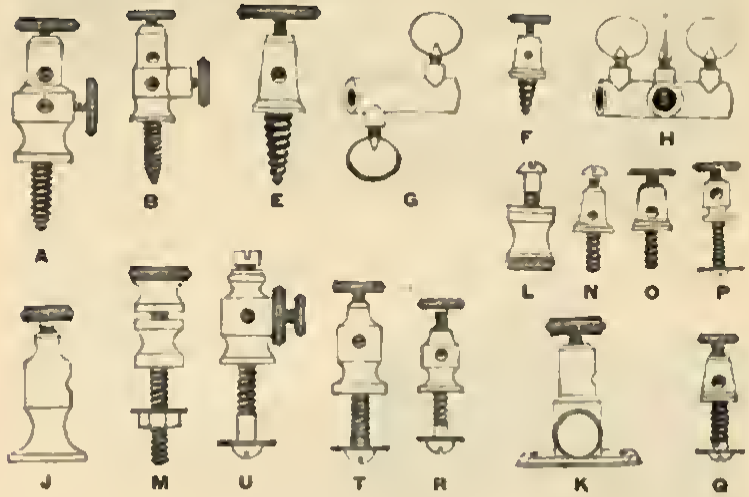
British P. O. Resonator.

With Sounder only	$4.25
Cord	0.25
Without Sounder and Cord	4.00

Wood Base Circular Switch.

	Solid Base Wire Connectors	Hollow Base Screw Connectors.
One point	$0.45	$0.15
Two points	.30	.17
Three points	.53	.19
Four points	.70	.24

BINDING POSTS.

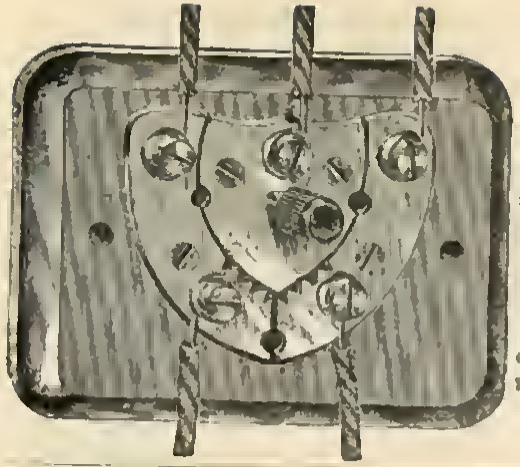


		Each	Per 100
A	Double Wood Screw Binding Post, fine finish	$0.17	$15.00
B	" " " " improved form	.14	11.00
E	Single Wood Screw Binding Post	.11	9.00
F	Small Wood Screw Binding Post, Single	.10	8.00
G	Plain Double Connector	.09	8.00
H	Three-Wire Triple Connector	.24	22.00
J	Window Tube Binding Post	.15	13.00
K	Double Binding Post, with flat Base	.17	15.00
L	Box Bell Binding Post	.10	7.00
M	English Pattern Binding Post	.18	15.00
N	Telephone Binding Post	.07	6.00
O	" " "	.09	7.00
P	Instrument Binding Post and Screw	.09	7.00
Q	Telephone Binding Post	.09	7.00
R	Instrument Binding Post and Screw	.09	7.00
S	" " "	.09	7.00
T	" " "	.11	9.00
U	Lightning Arrester Double Binding Post, takes office and line burn. wire	.15	13.00

Fuses and Holders for Telegraph and Instrument Work.

Designed for the absolute protection of sensitive Instruments from lightning or crosses with electric light or power current

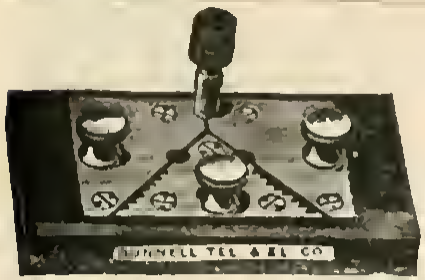
Fuse Holders . . each	$0.20
½ or ¾ Amp. Fuses, per 100	2.25
¾ to 3 " " "	4.50



Union Lightning Arrester AND Ground Wire Switch.

serves as
Peg Cut-Out Lightning Arrester and Ground Wire Switch.
It is an excellent and cheap form for amateur and all short lines.

Price.....60c.
Extra Pegs...10c.



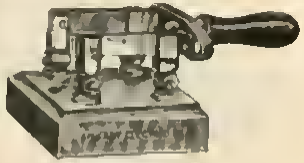
"TRIANGLE" Lightning Arrester AND Ground Wire Switch

For Short Lines, Etc.

Price .....$0 60.

Single Point Switch
Hard rubber base, 75c.

Two or three-point, 80c.



BABY KNIFE SWITCH

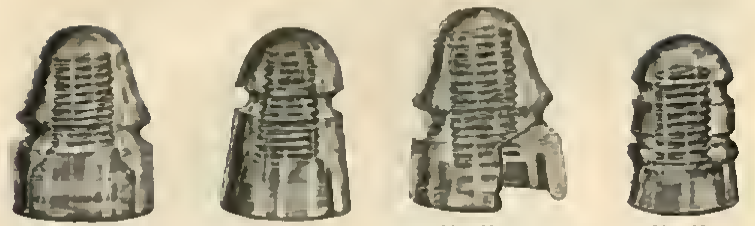
15 Amp. D P S T 35c
25 " ..... 40c.

WITH ROUND HARD RUBBER BASE, FOR 1, 2, 3 OR MORE POINTS.

A much more convenient Desk or Table Switch than the old form, with projecting wires from the bottom. All connections to this Switch being provided for with binding posts on the base.

Price, 1 or 2-point, $ .90 Price, 5-point, $1.20
" 3 or 4 " 1.00 " 6 " 1.25
" 8 " 1.70

GLASS INSULATORS.

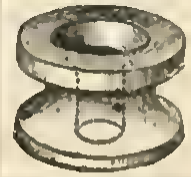


No 1 No. 3 No 11 No. 15.

No 1.	REGULAR,	Per 1000 ..... $42 00
No. 3.	PONY,	" " 28 50
No 11.	" DOUBLE PETTICOAT,	" " 38 50
No. 15.	" GROOVE,	" " 25 00

PORCELAIN INSULATORS.

No. 9 Insulator.
Price, per 1000 $10.68.
Height, 1⅝ in
Diam., ⅝ in.



No. 7 Insulator.
Price, per 1000 $10 00

PINS AND BRACKETS.

W. U. STANDARD, per 1000	$17 00	W. U. STANDARD OAK, per 1000	$20.00
PONY, " "	15 00	PONY, " "	18 00

INSULATING TAPE.

KERITE, per roll	$ .05	GRIMSHAW, Black, per roll	$ 75
GRIMSHAW, White, " "	1.00	STAR, White and Black, " "	.35

Competition Splicing Compound, a Substitute for "All Rubber Tape," per lb. 75c.

DOUBLE POINTED TACKS.

Style 1. Style 2

PRICES THE SAME FOR ALL SIZES

	Tinned	Coppered
In 2 oz boxes, per box	$0 10	$0 08
In 4 oz. boxes, per box	.15	.12
In bulk, price per lb	.20	.18

No. 1 is standard size and is furnished unless otherwise ordered.

WOOD CLEATS.

SCORED FOR FROM 1 TO 20 WIRES

BLACK WALNUT OR OAK OFFICE WIRE CLEATS

Price at the rate of 1 cent per wire
Special price for quantities.

WIRE.

Office Wire, Braidered, Paraffined and Compressed, in Coils

Nos. 12 to 15, B. & S. Gauge, per lb. $0.58
" 16 to 18, " " " ..... .61
" 19 and 20, " " " ..... .65

Moisture and Damp-Proof Office Wire.

Inside insulation black, with outer braid of any desired color.

12 B & S. Gauge, Moisture and Damp-Proof Office Wire, per lb. $0 58
14 " " " " 60
16 " " " " ..... .62
18 " " " " ..... .62

Annunciator Wire, on Spools, Double Cotton Wrepped, Waxed and Paraffined.

Nos 12 to 15, B & S. Gauge, per lb. $0 57
" 16 to 18, " " " ..... .60
" 19 and 20, " " " ..... .64

Galvanized Telegraph & Telephone Wire.

B W G.	Pounds per Mile	Resistance per Mile in Ohms @ 68° F				Price List Cents Per Pound		
		Extra Best	Best Best	Best Best	Steel	E. B. B.	B. B	Steel
6	573	8.21	9.6	11.35		10¾	9	7
7	459	10.40	12.21	14.43		10¾	9	7
8	373	12.42	14 53	17 18		10¾	9	7
9	305	15.44	18.06	21.35		10¾	9	7
10	250	18.83	22 04	26 08		10¾	9¼	7¼

Hard Drawn Copper Wire.

Size No. 14, weight per mile 65 lbs. ..... per lb $0 34
" 12 " " 110 " ..... " 32
" 10 " " 170 " ..... " 30

The Beekman Medical Apparatus.

The Beekman Medical Apparatus, with Battery, Coil and Electrodes complete.

Beekman Apparatus, with Battery and Electrodes Complete $8 00
Extra Battery, per Cell 0 40
Sponge Electrodes, with 2 handles, per pair 1 00
Tube Hand Electrodes, with 1 handle, per pair 3 75
Connecting Cords, 4 feet, with tips, per pair 3 40
Foot Plates, each 0 50
Hair Brush Electrodes (Extra), each 1 25
Special Flexible Sponge Electrode with binding strings attached (Extra), each 0.75

ACCOMMODATION TELEPHONES

Will work good on Metallic Circuit for 600 feet. Use copper wire No. 16. Two wires. Any one can connect them. By using a switch, three or more telephones can be connected in one system. Can be used from parlor to kitchen, floor to floor, room to room, house to barn, neighbor to neighbor, and factory use.

2 Telephones like Cut for

$7.50

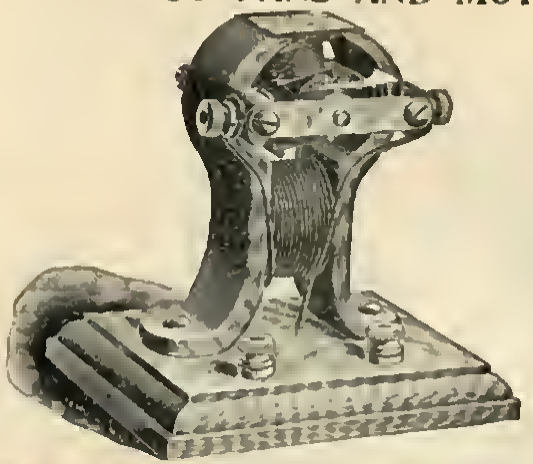
Including Dry Battery.

Cut, ½ Size.

This Efficient Machine is made of the very best material and guaranteed. It weighs 5 lbs.; measures 5½x4x3½ and is capable of carrying an 8 in. Fan if mounted on a Bracket.

Price $7.00
With 8 in. Fan 8.00

TOY FANS AND MOTORS.



Little Hustler Motor.

This Motor is finished in black enamel with nickel-plated trimmings. Has a three pole armature causing the motor to start without assistance when the current is applied. It drives a five inch fan at a high rate of speed; also used for running mechanical toys, models, etc.

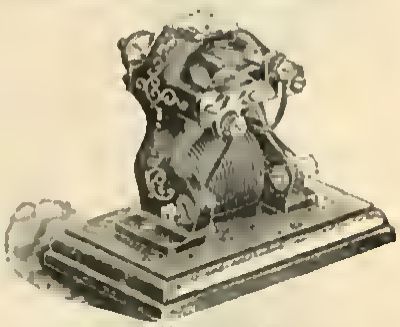
Price, $1.00

THE "AJAX."

The Ajax is the most accurate and best finished small motor manufactured. Finished in black enamel, decorated in gilt with nickel trimmings. It is particularly adapted for operating small mechanical devices, toy machinery and fans. It runs on a single cell of battery, open or closed circuit, dry cell or fluid. It is mounted on finished wood base.

WEIGHT, 1 lb.

Price, $1.50, with Fan, $1.75



"Ajax." Cut ½ Size.

THE "REX."

The Rex Motor finished in black enamel, screws and bearings nickel-plated, mounted on polished wood-stand. Used for operating small mechanical toys and advertising devices; runs on a single cell dry battery.

Price, $1.50.

With 3½ inch Fan, $1.75.

Crowfoot Gravity Battery.

For Telegraph and Closed Circuit Work.

	6x8	5x7
Cell, complete, less Vitriol	$1.20	$1.10
Zinc	.60	.46
Copper	.20	.18
Jars	.40	.48

Standard Fuller Battery.

Cell, complete, with Salammoniac	$0.75
Cylinder only, with Bushing	.45

ELECTRIC BELL OUTFITS.

OUTFIT No. 1, CALL BELL.

All of our Electric Bell sets are packed in boxes neatly labeled, and contain instructions how to fit up.

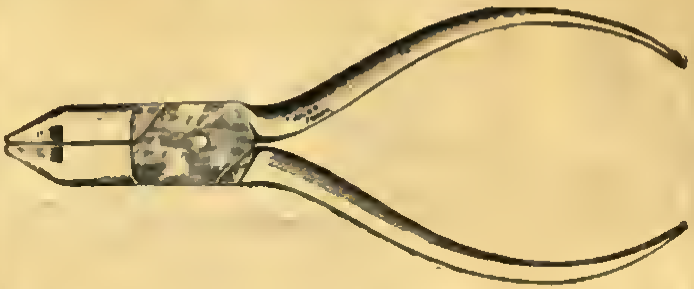
Outfit No. 1 consists of one 2½ inch Beekman Bell, Push Botton, Beekman Dry Battery, 75 feet Wire, Tape and Staples.

Price, - $1.00.

WIRE CLAMPS.

Steel for No. 8 Wire and Finer, $1.25.

SIDE CUTTING PLIERS.



Price, each, 6 in., $0.95; 7 in., $1.50; 8 in., $2.00

Hollow Handle Tool Set.

Contains

Screw Driver, Bit, Brad Awl, Tack Drawer, Chisel and Gouge.

Price, small size, $0.75; large size, $1.00.

Electricians' Scissors.

For the Manipulation of Fine Wires, Thin Sheet Insulations, and Metals, Stripping Wires, etc
5½ inches long, 1¾ inches Blade.
Highly Polished. Nickel-Plated.

Price, - - each $1.00.